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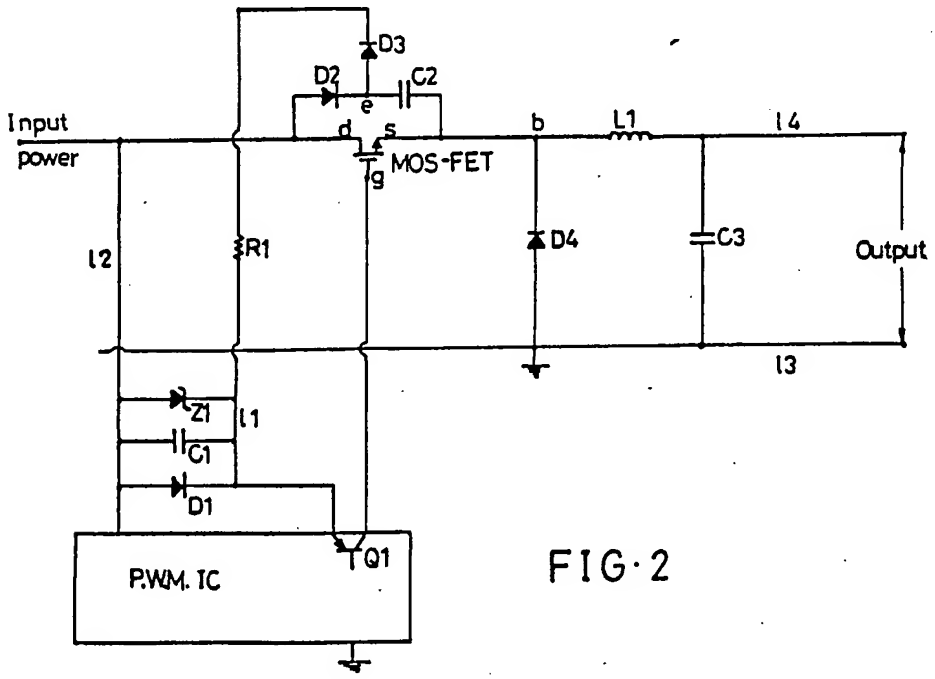
(54) **A regulated step-down switching circuit for the DC converter of a power supply**

(57) A regulated step-down switching circuit for the DC converter of a power supply consists of a pulse width modulator IC, a MOS-FET, a zener diode (Z1), a number of diodes (D1-D4), capacitors (C1-C3), resistor (R1), and an inductor (L1); wherein the drain of the MOS-FET is connected to a power supply, with its source being connected to the output lead. The gate of the MOSFET is connected to one of the transistors (Q1) within the the pulse width modulation IC. Between the source and the drain of the MOS-FET, a diode (D2) and a capacitor (2) are connected in series, and at the junction point (e) of this diode and the capacitor, a diode (D3) and resistor R1 are serially connected. The other end of the resistor (R1) is connected to the transistor (Q1) within the pulse width modulator IC, as well as being connected to the zener diode (Z1), capacitor (C1) and diode (D1) in parallel branches. The other ends of these parallel branches are connected to the power input lead and the pulse width modulator IC.



FIG·2

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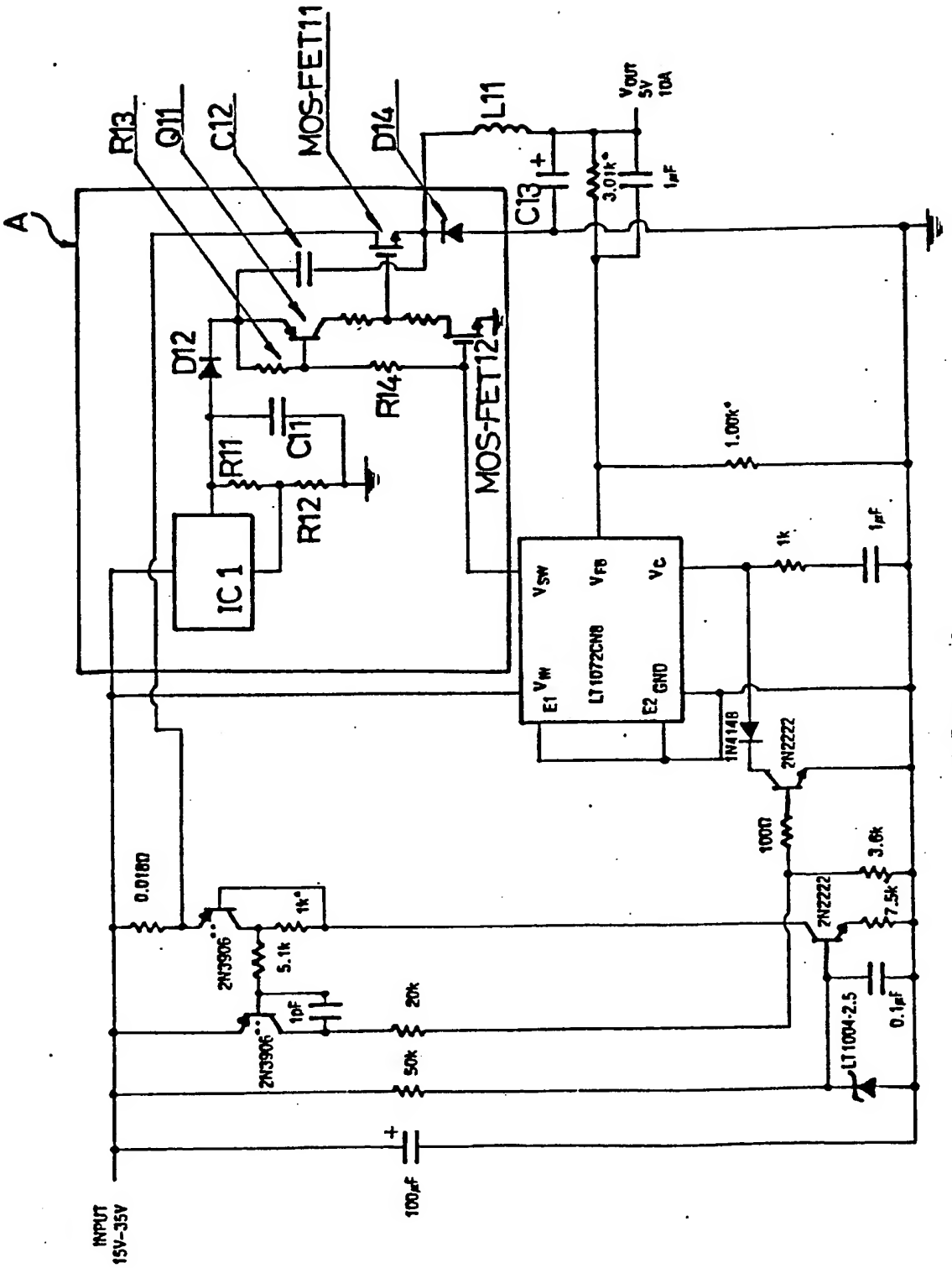
A
R13
Q11
C12
MOS-FET11
D14
L11
V_{OUT} 5V 10A
C13
3.01k*
1µF
D12
R14
MOS-FET12
R11
C11
R12
IC 1
1.00k*
1k
1µF
V_{SW}
V_{FB}
V_C
E1 V_{IN}
LT1072CN8
E2 GND
1N4148
2N2222
100Ω
3.6k
7.5k
2N2222
0.01Ω
1k*
2N3906
5.1k
1pF
20k
2N3906
50k
LT1004-2.5
0.1µF
100µF
INPUT
15V-35V

FIG.1

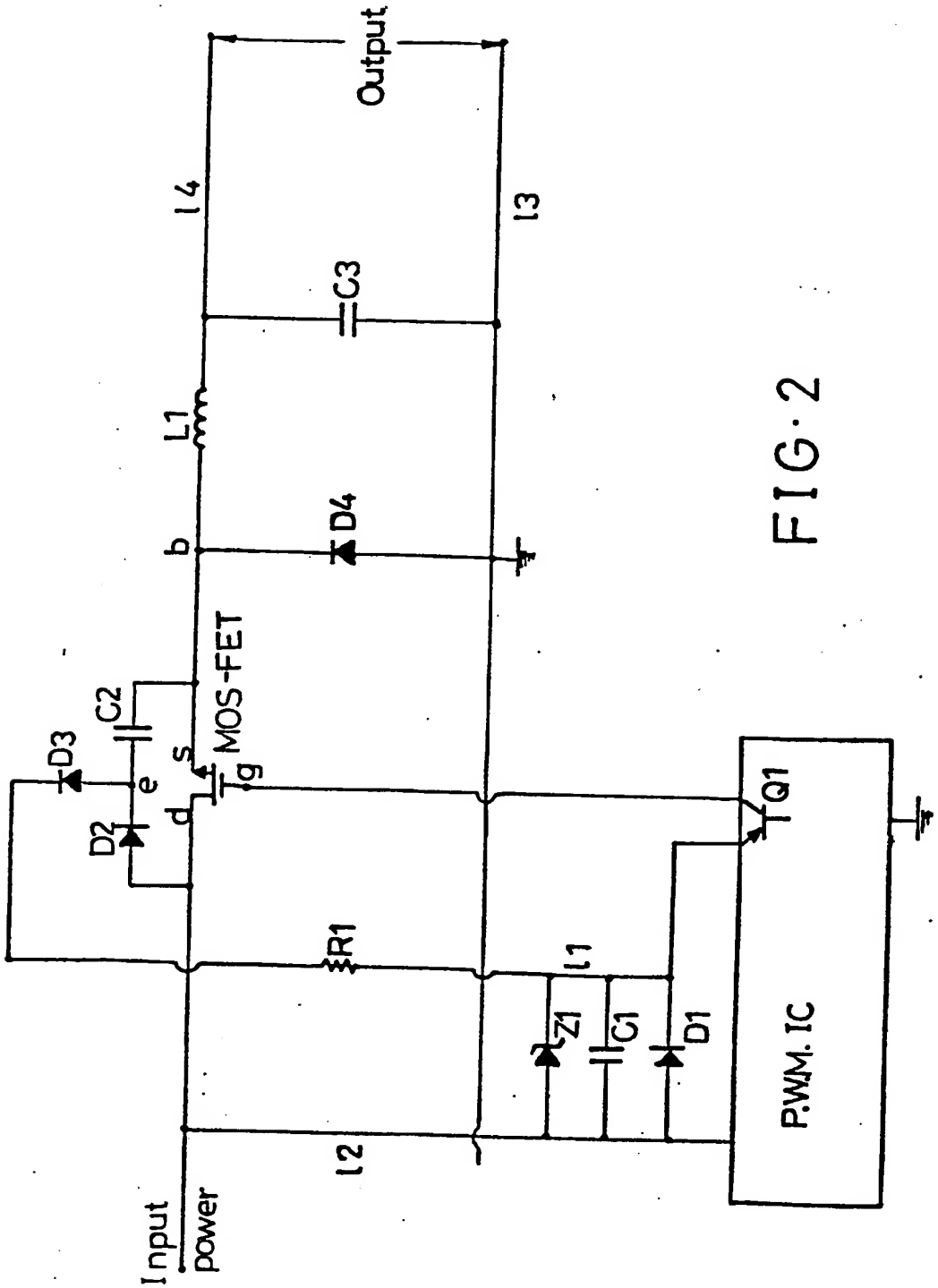
Output
l4
l3
C3
L1
b
D4
C2
D3
e
s
g
MOS-FET
D2
d
R1
l1
Z1
C1
D1
Q1
P.W.M. IC
l2
Input
power

FIG. 2

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A REGULATED STEP-DOWN SWITCHING CIRCUIT FOR THE DC CONVERTER OF A POWER SUPPLY

The present invention relates to a regulated step-down switching circuit for the DC converter of a power supply, in particular, including a pulse width modulation IC and a MOS-FET to regulate the step-down output from the DC converter of a power supply.

A power supply is an indispensable major part in computers, electronic devices and communication equipment, its main function being to provide a single or several regulated voltage sources for the said equipment.

A conventional regulated step-down switching circuit for the DC converter of a power supply can be represented by the circuit as shown within the solid line rectangular enclosure (A) in Fig. 1, which was developed by a U.S. firm "Linear Technology Corporation". This circuit comprises two metal-oxide-semiconductor field effect transistors (MOS-FET11 and MOS-FET12) a transistor (Q11), a voltage regulator (ICI), two diodes (D12 & D14), two capacitors (C11 and C12) and resistors (R11, R12, R13, R14 etc.). In this circuit, MOS-FET11 will become conductive when the voltage on the gate of MOS-FET11 is greater than the input voltage.

But this circuit possesses defects as follows:

(1) It requires two MOSFETS, a voltage regulator IC, a transistor, and a number of passive components such as capacitors, resistors etc.. Because of its complex in circuitry, more parts are required to construct such circuit, and consequently, not only its

product costs are therefore increased but also its reliability is reduced;

(2) The voltage regulator IC of this circuit is always maintained in a working state, therefore, it always consumes power.

In view of the defects of such a conventional regulated step-down switching circuit for the DC converter of a power supply, the purpose of the present invention is to provide an innovative regulated step-down switching circuit, which is simple in structure, precise in action, more reliable and more efficient in performance compared with conventional arrangements for the converter of a power supply.

Since the present invention has a simple circuit structure as compared with the conventional arrangements, the product costs can be reduced, which is one of the advantages of the present invention, and because it also uses less active and passive components, it is more efficient as compared with the conventional arrangements, and better reliability can be expected.

Furthermore, compared with the conventional circuits, which consume power constantly, the present invention operates only when the voltage increases, so it is energy-saving. This is another advantage of the present invention.

The present invention will be described further by way of example, with reference to the accompanying drawings, in which:

Fig. 1 referred to above shows a conventional regulated step-down switching circuit (enclosed by a solid line rectangle A) for the DC converter of a power

supply; and

Fig. 2 is the regulated step-down switching circuit of the present invention.

Referring to the Fig. 2, the present invention comprises a MOS-FET, a pulse width modulation (PWM) IC, a zener diode (Z1), diodes (D1, D2, D3 and D4), capacitors (C1, C2 and C3), a resistor (R1), an inductor (L1) and etc.; wherein, the drain 'd' of the MOS-FET is connected to the power input, the source 's' is connected to the power output terminal via an inductor L1, and the gate 'g' is connected to one of the PNP or NPN transistors Q1 inside the PWM IC. Between the drain 'd' and the source 's', a diode D2 and a capacitor C2 are connected in series, and at the junction point of D2 and C2 a diode D3 and a resistor R1 are connected in series. The free end of the resistor R1 is connected to the transistor Q1 inside the PWM IC. A lead wire 12 is provided to connect the power input terminal and the PWM IC for furnishing power to the same, and between lead wires 11 and 12, are connected a zener diode Z1, a capacitor C1, and a diode D1 in parallel. A ground lead wire 13 is furnished to connect the input power ground terminal and the output power ground terminal and also the two terminals of L1 are connected via respective diode D4 and capacitor C3 parallel branches to ground lead wire 13.

The operating principles of the present invention are described as follows:

In general, a MOS-FET goes into conductive state only when its gate voltage (Vg) becomes greater than the input power voltage (Vin) for 6 to 15 volts. In the present invention, when input power is just switched on, the potential at point 'b' is Vb=0,

therefore, capacitor C2 starts charging to a potential VC2, which equals the potential difference between input power voltage Vin and diode D2's voltage drop VD2, i.e. VC2=Vin-VD2. At this time, transistor Q1, inside the PWM IC, starts to operate, which causes the MOS-FET to go into a conductive state and the potential Vb at the point 'b' therefore rises. The potential Ve at the junction point 'd' of capacitor C2 and diode D2 can be represented by: Ve=VD4+VC2; therefore, when the voltage is rising, potential Ve will become greater than potential Vin, which makes a part of the circuit of the present invention operate. In the meantime, the diode D3 conducts, the capacitor C1 charges, and when the potential VC1 rises to a level which is greater than Vin, the whole circuit will then go into operation.

From the above statement, it can be understood that the circuit of the present invention utilizes a zener diode Z1, a MOS-FET, a PWM IC as its major parts. In comparison with the typical conventional step-down regulated circuit developed by "Linear Technology Corporation" U.S.A., a lot of parts as well as the product costs can be saved. Furthermore, since the present invention operates only when the voltage is rising, it will not consume the power constantly, so it is energy-saving, precise in action and reliable in its performance.

Although the present invention has been described with a certain degree of particularity, the present disclosure has been made by way of example and changed in details of structure may be made without departing from the scope thereof.

CLAIMS

1. A regulated step-down switching circuit for the DC converter of a power supply, comprising a PWM IC, a MOS-FET, a zener diode, diodes, capacitors, resistors and an inductor; wherein a first diode and a first capacitor are connected in series between the source and the drain of the MOS-FET, and a second diode and resistor are connected in series between the first diode and first capacitor and a transistor of the PWM IC, the input power supply being connected as the power source to the PWM IC and at the junction point between said resistor and said transistor, a zener diode, a capacitor and a diode are connected in parallel to the power input.

2. A regulated step-down switching circuit for the DC converter of a power supply, substantially as herein described with reference to the accompanying drawings.

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